

① Use Synthetic division to find the upper and lower bounds of the real zeros of $f(x) = 2x^3 - 3x^2 - 12x + 8$.

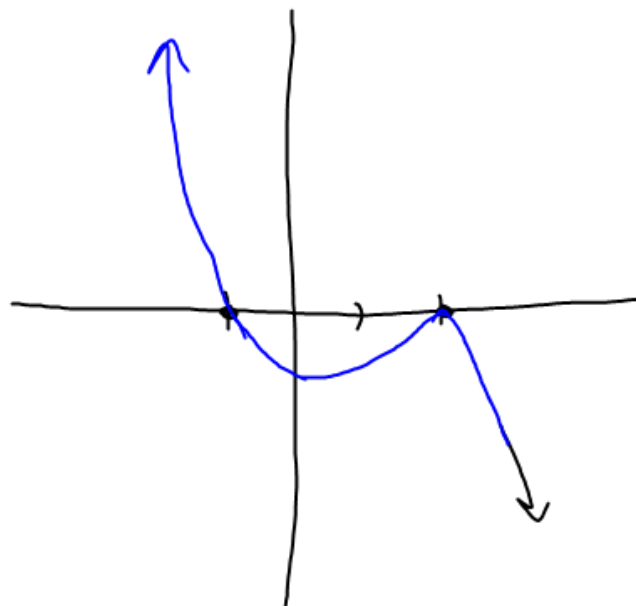
② Without a calculator, sketch a graph of $f(x) = -\frac{1}{3}(x+1)(x-2)^2$.

degree 3

L.C. neg

Zeros

-1, 2
 ↓ ↓
 cross bounce



$$f(x) = 2x^3 - 3x^2 - 12x + 8.$$

Rational
Zero
Test

$$\frac{\pm 1 \pm 2 \pm 4 \pm 8}{\pm 1 \pm 2}$$

positive $\rightarrow 4$

2	-3	-12	8
	8	20	32
2	5	8	40

all positive \rightarrow

Zero - wild
card

neg. $\rightarrow -4$

2	-3	-12	8
	-8	44	-128
2	-11	32	-120

alternates
pos./neg.

Review

- { p.101 Even/odd functions
- { p.101 Leading coefficient
- { p.104 Even/odd multiplicity
- p.107 Intermediate value theorem
- p.112 Long \div polynomials
- p.115 Synthetic \div (restrictions)

- p.116 Remainder theorem
- p.118 Rational zero test
- p.120 Descartes's Rule signs
- p.121 Upper/lower bounds
- Sect. 2.4 Complex #

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The diagram illustrates the hierarchy of number systems. A large outer rectangle is labeled "Complex" at the top right, with the example $2+3i$ written next to it. Inside this rectangle is a large circle labeled "Real" at the top. To the right of the "Real" circle is a separate circle labeled "Imaginary" in blue, containing $\sqrt{-1}$ and $5i$. Below the "Imaginary" circle is an arrow pointing to the expression $0+3i$. Inside the "Real" circle are two smaller circles. The left one is labeled "Rational" and contains $\frac{1}{2}$ and $0.\overline{33}$. Inside the "Rational" circle are two more concentric circles: the innermost is labeled "Whole" and contains $0, 1, 2, 3, 4$; the middle one is labeled "Integers" and contains $\dots, -3, -2, -1, 0, 1, 2, 3, \dots$. To the right of the "Rational" circle is another circle labeled "Irrationals" containing $\pi, \sqrt{2}$ and e . Below the "Real" circle is the expression $6+0i$.

Complex $2+3i$

Real

Rational $\frac{1}{2}, 0.\overline{33}$

Integers $\dots, -3, -2, -1, 0, 1, 2, 3, \dots$

Whole $0, 1, 2, 3, 4$

Irrationals $\pi, \sqrt{2}, e$

Imaginary $\sqrt{-1}, 5i$

$6+0i$

$0+3i$

Done

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$$i = \sqrt{-1}$$

$$i^2 = -1$$

$$x^2 + 1 = 0$$

$$\begin{matrix} -1 & -1 \end{matrix}$$

$$x^2 = -1$$

$$\sqrt{} \quad \sqrt{}$$

$$x = \pm \sqrt{-1}$$

$$x = \pm i$$

$$\sqrt{100} = 10i$$

$$\sqrt{-25} = 5i$$

$$\sqrt{-7} = \sqrt{7}i$$

$$\sqrt{-8} = 2\sqrt{2}i$$

So, root asks what times itself equals the number in the $\sqrt{}$

$\sqrt{4} \rightarrow 2 \cdot 2$
 $\phantom{\sqrt{4}} -2 \cdot -2$

Done

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$$(2 + 3i) + (4 + 5i) = 6 + 8i$$

$$(3 - 2i) - (6 + 3i) = -3 - 5i$$

$$6 - (3 + 2i) = 3 - 2i$$

$$(6 + 0i) - (3 + 2i) = 3 - 2i$$

$$(3 + 2i)(4 + 3i)$$

$$12 + 9i + 8i + 6i^2$$

$$12 + 17i + 6i^2$$

$$12 + 17i + 6(-1)$$

$$\boxed{6 + 17i}$$

Done

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$$\frac{\frac{1}{4}}{\frac{2}{3}} \Rightarrow \frac{1}{4} \cdot \frac{3}{2} = \boxed{\frac{3}{8}}$$

$$\frac{1}{\sqrt{2}} \cdot \frac{\sqrt{2}}{\sqrt{2}} = \boxed{\frac{\sqrt{2}}{2}}$$

Write in standard form

$$\frac{2+3i}{4-2i} \text{ mult. by conjugate of the bottom}$$

$$\frac{2+3i}{4-2i} \cdot \frac{4+2i}{4+2i} = \frac{8+16i+12i^2}{16-4i^2} = \frac{8+16i-12}{16+4} = \frac{-4+16i}{20} = \boxed{\frac{-1}{5} + \frac{4}{5}i}$$

Done

Fundamental Theorem of Algebra

→ a polynomial with degree n has exactly n zeros,
and n linear factors.

$$x^5 \rightarrow (\quad)(\quad)(\quad)(\quad)(\quad)$$

2.5a

Find the zeros and factors of each polynomial and show your understanding of synthetic division and rational zero test and upper/lower bounds.

① $f(x) = x^4 - 5x^3 + 15x^2 - 45x + 54$

② $f(x) = x^4 + 2x^3 + 10x^2 + 18x + 9$

③ $f(x) = x^5 + x^3 + 2x^2 - 12x + 8$

④ $f(x) = x^3 + 4x$

⑤ $f(x) = x^4 - 3x^3 + 6x^2 + 2x - 60$